




TEST REPORT


Test Report No. : UL-RPT-RP89921JD22A V3.0

Manufacturer : Bang & Olufsen a/s
Model No. : BeoPlay A9
FCC ID : TTUBEOPLAYA9
IC Certification No. : 3775B-BEOPLAYA9
Test Standard(s) : FCC Part 15.247: 2012 Subpart C, RSS-210 Issue 8 December 2010 & RSS-Gen Issue 3 December 2010 4.6.1, 4.6.2, 4.8, 4.9, 4.10, 6.1 & 7.2.4

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2. The results in this report apply only to the sample(s) tested.
3. This sample tested is in compliance with the above standard(s).
4. The test results in this report are traceable to the national or international standards.
5. Version 3.0 supersedes all previous versions.

Date of Issue: 14 February 2014

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This laboratory is accredited by UKAS. The tests reported herein have been performed in accordance with its' terms of accreditation.

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1. Customer Information












Company Name:	Bang & Olufsen a/s
Address:	Peter Bangs Vej 15 7600 Struer Denmark

2. Summary of Testing

2.1. General Information

Specification Reference:	47CFR15.247
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications) 2012: Part 15 Subpart C (Intentional Radiators) – Section 15.247
Specification Reference:	47CFR15.107 and 47CFR15.109
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications) 2012: Part 15 Subpart B (Unintentional Radiators) – Sections 15.107 and 15.109
Specification Reference:	47CFR15.207 and 47CFR15.209
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications) 2012: Part 15 Subpart C (Intentional Radiators) – Sections 15.207 and 15.209
Specification Reference:	RSS-Gen Issue 3 December 2010
Specification Title:	General Requirements and Information for the Certification of Radio Apparatus
Specification Reference:	RSS-210 Issue 8 December 2010
Specification Title:	Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment.
Site Registration:	FCC: 209735, Industry Canada: 3245B-2
Location of Testing:	UL VS LTD, Unit 3 Horizon, Wade Road, Kingsland Business Park, Basingstoke, Hampshire, RG24 8AH, United Kingdom
Test Dates:	18 September 2012 to 26 April 2013

2.2. Summary of Test Results

FCC Reference (47CFR)	IC Reference	Measurement	Result
Part 15.107(a)	RSS-Gen 7.2.4	Receiver/Idle Mode AC Conducted Emissions	
Part 15.109	RSS-Gen 4.10/6.1	Receiver/Idle Mode Radiated Spurious Emissions	
Part 15.207	RSS-Gen 7.2.4	Transmitter AC Conducted Emissions	
Part 15.247(a)(2)	RSS-Gen 4.6.2 RSS-210 A8.2(a)	Transmitter Minimum 6 dB Bandwidth	
N/A	RSS-Gen 4.6.1	Transmitter 99% Occupied Bandwidth	
Part 15.247€	RSS-210 A8.2(b)	Transmitter Power Spectral Density	
Part 15.247(b)(3)	RSS-Gen 4.8 RSS-210 A8.4(4)	Transmitter Maximum Peak Output Power	
Part 15.247(d)/ 15.209(a)	RSS-Gen 4.9 RSS-210 A8.5	Transmitter Radiated Emissions	
Part 15.247(d)/ 15.209(a)	RSS-Gen 4.9 RSS-210 A8.5	Transmitter Band Edge Radiated Emissions	
Key to Results			
 = Complied  = Did not comply			

2.3. Methods and Procedures

Reference:	ANSI C63.4 (2003)
Title:	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
Reference:	ANSI C63.10 (2009)
Title:	American National Standard for Testing Unlicensed Wireless Devices
Reference:	FCC KDB 558074 D01 v02 10/04/2012
Title:	Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247
Reference:	FCC KDB 558074 D01 v03 April 8, 2013
Title:	Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247

2.4. Deviations from the Test Specification

For the measurements contained within this test report, there were no deviations from, additions to, or exclusions from the test specification identified above.

3. Equipment Under Test (EUT)

3.1. Identification of Equipment Under Test (EUT)

Brand Name:	Bang & Olufsen
Model Name or Number:	BeoPlay A9
Serial Number:	23168481 (<i>Radiated sample #1</i>)
Hardware Version Number:	C
Software Version Number:	6.4
FCC ID:	TTUBEOPLAYA9
Industry Canada Certification Number:	3775B-BEOPLAYA9

Brand Name:	Bang & Olufsen
Model Name or Number:	BeoPlay A9
Serial Number:	91260 (<i>Radiated sample #2</i>)
Hardware Version Number:	C
Software Version Number:	6.4
FCC ID:	TTUBEOPLAYA9
Industry Canada Certification Number:	3775B-BEOPLAYA9

Brand Name:	Bang & Olufsen
Model Name or Number:	BeoPlay A9
Serial Number:	91257 (<i>Conducted RF port sample #1</i>)
Hardware Version Number:	C
Software Version Number:	6.4
FCC ID:	TTUBEOPLAYA9
Industry Canada Certification Number:	3775B-BEOPLAYA9

Brand Name:	Bang & Olufsen
Model Name or Number:	BeoPlay A9
Serial Number:	91262 (<i>Conducted RF port sample #2</i>)
Hardware Version Number:	C
Software Version Number:	6.4
FCC ID:	TTUBEOPLAYA9
Industry Canada Certification Number:	3775B-BEOPLAYA9

3.2. Description of EUT

The equipment under test was a WLAN audio speaker operating at 2.4 GHz.

3.3. Modifications Incorporated in the EUT

No modifications were applied to the EUT during testing.

3.4. Additional Information Related to Testing

Technology Tested:	Digital Transmission System (IEEE 802.11b/g)		
Type of Unit:	Transceiver		
Modulation:	CCK, DBPSK, DQPSK, BPSK, QPSK, 16QAM & 64QAM		
Data Rates:	802.11b	1, 2, 5.5 & 11 Mbps	
	802.11g	6, 9, 12, 18, 24, 36, 48 & 54 Mbps	
Power Supply Requirement(s):	Nominal	120 VAC 60 Hz	
Maximum Conducted Output Power:	21.8 dBm		
Channel Spacing:	20 MHz		
Transmit / Receive Frequency Band:	2400 MHz to 2483.5 MHz		
Transmit / Receive Channels Tested:	Channel ID	Channel Number	Channel Frequency (MHz)
	Bottom	1	2412
	Middle	6	2437
	Top	11	2462

3.5. Support Equipment

The following support equipment was used to exercise the EUT during testing:

Description:	Laptop PC
Brand Name:	Dell
Model Name or Number:	D610
Serial Number:	PC 379NT

Description:	Serial Cable
Brand Name:	Not marked or stated
Model Name or Number:	Not marked or stated

Description:	USB UART adaptor
Brand Name:	Not marked or stated
Model Name or Number:	Not marked or stated

3.6. Antenna

Type	Stated Gain (dBi)	Manufacturer	Antenna Name
PUCK	1.6	TE Connectivity	A29

4. Operation and Monitoring of the EUT during Testing

4.1. Operating Modes

The EUT was tested in the following operating mode(s):

- Receive/Idle mode.
- Continuously transmitting at maximum power on the bottom, middle and top channels as required using the supported data rates/modulation schemes.

4.2. Configuration and Peripherals

The EUT was tested in the following configuration(s):

- Controlled using a terminal emulator program (Tera Term) on a UL test laptop with instructions supplied by the Customer. The provided instructions were used to enable continuous transmission and idle mode (enabled but not transmitting) and to select the test channels, data rates, power settings and modulation schemes as required.
- Receive/Idle tests: The 802.11 mode was active but not transmitting.
- All supported modes and channel widths were initially investigated on one channel. The modes that produced the highest power, narrowest and widest bandwidths were:
 - Highest power
 - 802.11b – CCK / 11 Mbps
 - 802.11g – 64QAM / 48 Mbps
 - Narrowest bandwidth
 - 802.11b – CCK / 11 Mbps
 - 802.11g – BPSK / 9 Mbps
 - 99% Occupied bandwidth
 - 802.11b – CCK / 11 Mbps
 - 802.11g – 64QAM / 48 Mbps
 - Widest bandwidth
 - 802.11b – DQPSK / 2 Mbps
 - 802.11g – 64QAM / 54 Mbps
- The EUT was tested at power settings declared by the Customer as stated below:
 - 802.11b – 9
 - 802.11g – 1
- Transmitter spurious emissions were performed with the EUT transmitting with a data rate of 11 Mbps as this was found to have the highest power level and therefore deemed worst case.
- Radiated emissions tests were performed with all unused ports terminated.

5. Measurements, Examinations and Derived Results

5.1. General Comments

Measurement uncertainties are evaluated in accordance with current best practice. Our reported expanded uncertainties are based on standard uncertainties, which are multiplied by an appropriate coverage factor to provide a statistical confidence level of approximately 95%. Please refer to *Section 6 Measurement Uncertainty* for details.

In accordance with UKAS requirements all the measurement equipment is on a calibration schedule. All equipment was within the calibration period on the date of testing.

5.2. Test Results**5.2.1. Receiver/Idle Mode AC Conducted Spurious Emissions****Test Summary:**

Test Engineer:	Sandeep Bharat	Test Date:	26 March 2013
Test Sample Serial Number:	91262		

FCC Part:	15.107(a)
Industry Canada Reference:	RSS-Gen 7.2.4
Test Method Used:	As detailed in ANSI C63.10 Section 6.2 referencing ANSI C63.4

Environmental Conditions:

Temperature (°C):	21
Relative Humidity (%):	29

Receiver/Idle Mode AC Conducted Spurious Emissions (continued)**Results: Live / Quasi Peak**

Frequency (MHz)	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.501	18.9	56.0	37.1	Complied
0.843	24.7	56.0	31.3	Complied
1.167	20.0	56.0	36.0	Complied
2.135	26.2	56.0	29.8	Complied
2.225	24.4	56.0	31.6	Complied
3.309	31.6	56.0	24.4	Complied

Results: Live / Average

Frequency (MHz)	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.299	24.9	50.3	25.4	Complied
0.371	23.4	48.5	25.1	Complied
0.393	22.4	48.0	25.6	Complied
0.969	19.1	46.0	26.9	Complied
2.234	19.3	46.0	26.7	Complied
2.328	18.1	46.0	27.9	Complied

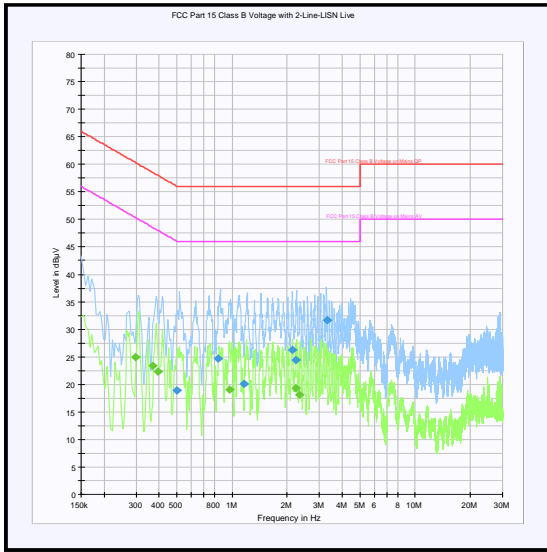
Results: Neutral / Quasi Peak

Frequency (MHz)	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.150	37.7	66.0	28.3	Complied
3.174	27.0	56.0	29.0	Complied
3.278	33.7	56.0	22.3	Complied
4.326	32.8	56.0	23.2	Complied
7.404	29.0	60.0	31.0	Complied

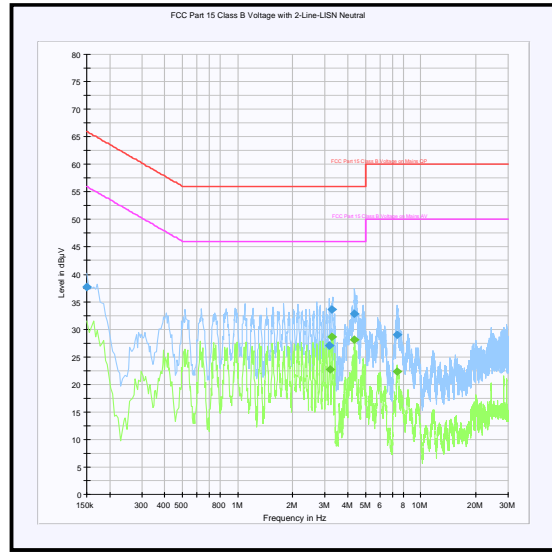
Results: Neutral / Average

Frequency (MHz)	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
3.183	22.7	46.0	23.3	Complied
3.278	28.6	46.0	17.4	Complied
4.326	28.2	46.0	17.8	Complied
7.340	22.4	50.0	27.6	Complied

Receiver/Idle Mode AC Conducted Spurious Emissions (continued)



Live



Neutral

Note: This plot is a pre-scan and for indication purposes only. For final measurements, see accompanying tables.

Test Equipment Used:

Asset No.	Instrument Description	Model Number	Calibration Due	Calibration Interval (Months)
A649	LISN	ESH3-Z5	19 Apr 2013	12
A1830	Pulse Limiter	ESH3-Z2	19 Feb 2014	12
M1263	Test Receiver	ESIB7	09 Aug 2013	12

In accordance with UKAS requirements all the measurement equipment is on a calibration schedule. All equipment was within the calibration period on the date of testing.

5.2.2. Receiver/Idle Mode Radiated Spurious Emissions**Test Summary:**

Test Engineer:	Nick Steele	Test Date:	18 September 2012
Test Sample Serial Number:	23168481		

FCC Reference:	Part 15.109
Industry Canada Reference:	RSS-Gen 4.10
Test Method Used:	As detailed in ANSI C63.10 Sections 6.3 and 6.5 referencing ANSI C63.4
Frequency Range:	30 MHz to 1000 MHz

Environmental Conditions:

Temperature (°C):	26
Relative Humidity (%):	34

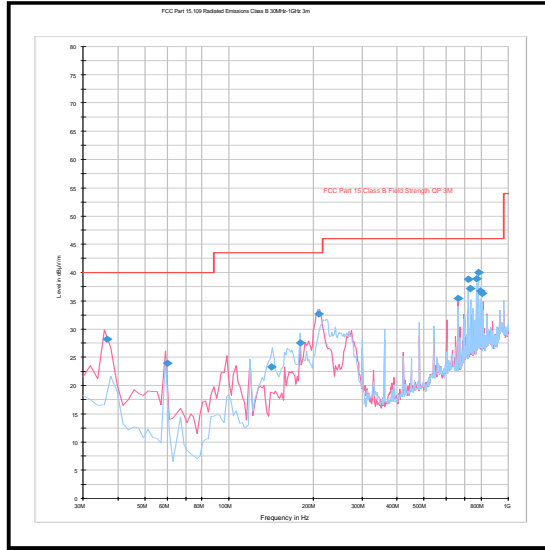
Note(s):

1. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
2. All other emissions shown on the pre-scan plot were investigated and found to be ambient or >20 Db below the applicable limit or below the measurement system noise floor.
3. Measurements below 1 GHz were performed in a semi-anechoic chamber (Asset Number K0001) at a distance of 3 metres. The EUT was placed at a height of 80 cm above the reference ground plane in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.

Results: Quasi Peak

Frequency (MHz)	Antenna Polarity	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Result
36.587	Vertical	28.2	40.0	11.8	Complied
60.029	Vertical	23.9	40.0	16.1	Complied
141.798	Horizontal	23.2	43.5	20.3	Complied
180.002	Horizontal	27.5	43.5	16.0	Complied
209.978	Vertical	32.7	43.5	10.8	Complied
660.007	Vertical	35.4	46.0	10.6	Complied
720.018	Horizontal	38.8	46.0	7.2	Complied
768.018	Horizontal	38.9	46.0	7.1	Complied
779.999	Horizontal	40.0	46.0	6.0	Complied
804.019	Horizontal	36.3	46.0	9.7	Complied

Receiver/Idle Mode Radiated Spurious Emissions (continued)



Note: This plot is a pre-scan and for indication purposes only. For final measurements, see accompanying table.

Test Equipment Used:

Asset No.	Instrument Description	Model Number	Calibration Due	Calibration Interval (Months)
K0001	5m RSE Chamber	Rainford	31 Oct 2012	12
M1273	Test Receiver	ESIB 26	03 Feb 2013	12
A1834	Attenuator	8491B	29 Jan 2013	12
G0543	Amplifier	310N	15 Oct 2012	3
A553	Antenna	CBL6111A	15 Feb 2013	12

In accordance with UKAS requirements all the measurement equipment is on a calibration schedule. All equipment was within the calibration period on the date of testing.

Receiver/Idle Mode Radiated Spurious Emissions (continued)**Test Summary:**

Test Engineers:	Andrew Edwards & Nick Steele	Test Dates:	19 September 2012 & 27 September 2012
Test Sample Serial Number:	23168481		

FCC Reference:	Part 15.109
Industry Canada Reference:	RSS-Gen 4.10
Test Method Used:	As detailed in ANSI C63.10 Sections 6.3 and 6.6 referencing ANSI C63.4
Frequency Range:	1 GHz to 12.75 GHz

Environmental Conditions:

Temperature (°C):	25
Relative Humidity (%):	33 to 40

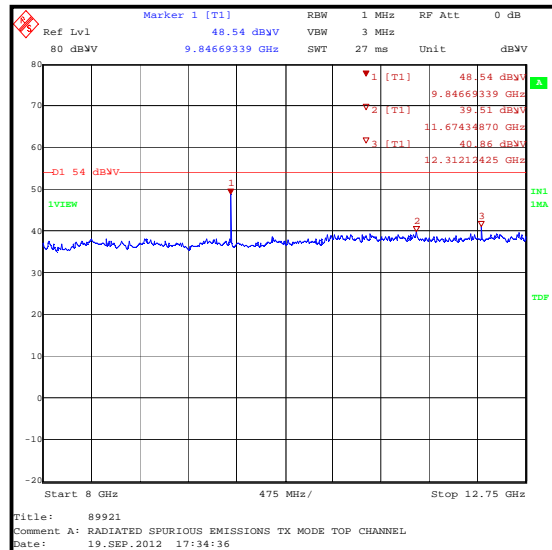
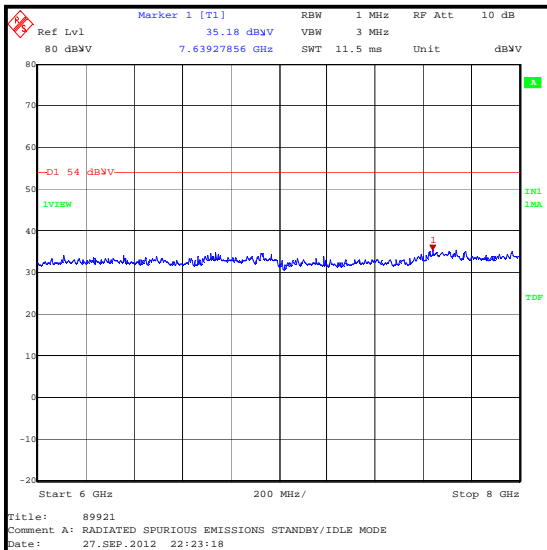
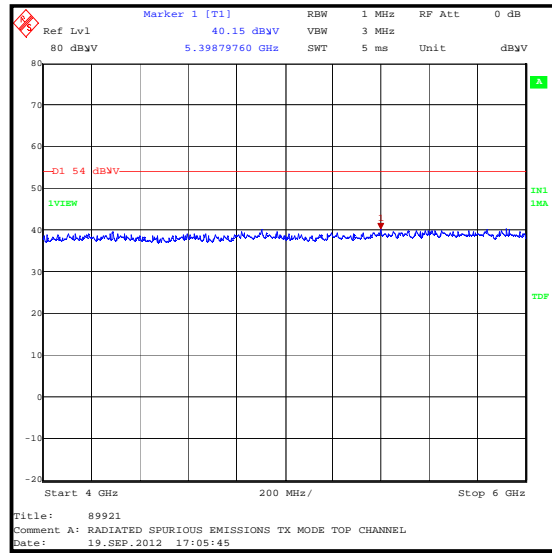
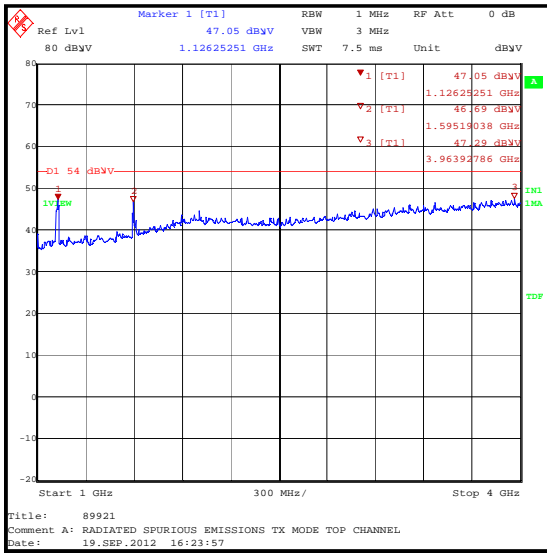
Note(s):

1. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
2. Pre-scans above 1 GHz were performed in a fully anechoic chamber (Asset Number K0002) at a distance of 3 metres. The EUT was placed at a height of 1.5 metres above the test chamber floor in the centre of the chamber turntable. All measurement antennas were placed at a fixed height of 1.5 metres above the test chamber floor, in line with the EUT. Final measurements above 1 GHz were performed in a semi-anechoic chamber (Asset Number K0001) at a distance of 3 metres. The EUT was placed at a height of 80 cm above the reference ground plane in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.
3. The peak level was compared to the average limit as opposed to being compared to the peak limit because this is the more onerous limit.
4. The plots in frequency ranges 1 to 4 GHz, 4 to 6 GHz and 8 to 12.75 GHz have the incorrect title on.

Results:

Frequency (MHz)	Antenna Polarity	Level (dBμV/m)	Average Limit (dBμV/m)	Margin (dB)	Result
1130.686	Vertical	47.7	54.0	6.3	Complied
1597.279	Vertical	48.2	54.0	5.8	Complied
9847.972	Horizontal	49.4	54.0	4.6	Complied
12309.788	Horizontal	42.3	54.0	11.7	Complied

Receiver/Idle Mode Radiated Spurious Emissions (continued)



Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

Receiver/Idle Mode Radiated Spurious Emissions (continued)**Test Equipment Used:**

Asset No.	Instrument Description	Model Number	Calibration Due	Calibration Interval (Months)
A253	Antenna	12240-20	09 Oct 2012	12
A254	Antenna	14240-20	09 Oct 2012	12
A255	Antenna	16240-20	09 Oct 2012	12
A1534	Pre Amplifier	8449B	09 Oct 2012	12
A1818	Antenna	3115	09 Oct 2012	12
K0002	3m RSE Chamber	N/A	09 Oct 2012	12
M1124	Test Receiver	ESIB 26	14 Aug 2013	12

In accordance with UKAS requirements all the measurement equipment is on a calibration schedule. All equipment was within the calibration period on the date of testing.

5.2.3. Transmitter AC Conducted Spurious Emissions**Test Summary:**

Test Engineer:	Sandeep Bharat	Test Date:	26 March 2013
Test Sample Serial Number:	91262		

FCC Reference:	Part 15.207
Industry Canada Reference:	RSS-Gen 7.2.4
Test Method Used:	As detailed in ANSI C63.10 Section 6.2 referencing ANSI C63.4

Environmental Conditions:

Temperature (°C):	21
Relative Humidity (%):	29

Transmitter AC Conducted Spurious Emissions (continued)**Results: Live / Quasi Peak**

Frequency (MHz)	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.344	36.3	59.1	22.8	Complied
0.762	24.5	56.0	31.5	Complied
2.234	33.4	56.0	22.6	Complied
4.569	25.1	56.0	30.9	Complied
5.631	20.2	60.0	39.8	Complied

Results: Live / Average

Frequency (MHz)	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.339	36.9	49.2	12.3	Complied
0.753	29.7	46.0	16.3	Complied
2.211	29.3	46.0	16.7	Complied
4.623	23.1	46.0	22.9	Complied
5.870	19.0	50.0	31.0	Complied

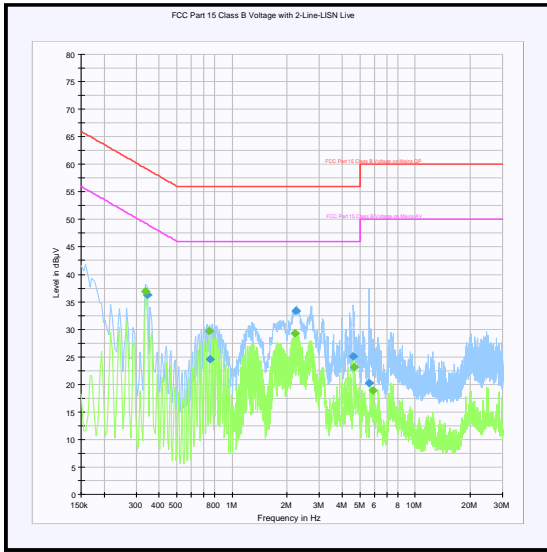
Results: Neutral / Quasi Peak

Frequency (MHz)	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.339	35.0	59.2	24.2	Complied
0.636	25.4	56.0	30.6	Complied
2.666	31.0	56.0	25.0	Complied
4.511	26.7	56.0	29.3	Complied
27.402	18.6	60.0	41.4	Complied

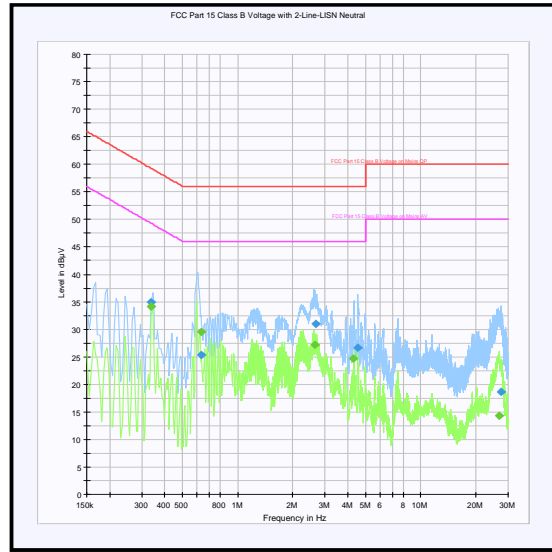
Results: Neutral / Average

Frequency (MHz)	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.339	34.2	49.2	15.0	Complied
0.632	29.5	46.0	16.5	Complied
2.648	27.2	46.0	18.8	Complied
4.286	24.7	46.0	21.3	Complied
26.696	14.3	50.0	35.7	Complied

Transmitter AC Conducted Spurious Emissions (continued)



Live



Neutral

Note: This plot is a pre-scan and for indication purposes only. For final measurements, see accompanying table.

Test Equipment Used:

Asset No.	Instrument Description	Model Number	Calibration Due	Calibration Interval (Months)
A649	LISN	ESH3-Z5	19 Apr 2013	12
A1830	Pulse Limiter	ESH3-Z2	19 Feb 2014	12
M1263	Test Receiver	ESIB7	09 Aug 2013	12

In accordance with UKAS requirements all the measurement equipment is on a calibration schedule. All equipment was within the calibration period on the date of testing.

5.2.4. Transmitter Minimum 6 dB Bandwidth**Test Summary:**

Test Engineer:	Sandeep Bharat	Test Dates:	25 March 2013 & 19 April 2013
Test Sample Serial Number:	91257		

FCC Reference:	Part 15.247(a)(2)
Industry Canada Reference:	RSS-Gen 4.6.2 / RSS-210 A8.2(a)
Test Method Used:	As detailed in FCC KDB 558074 D01 v02 Section 7.1 & v03 Section 8.1

Environmental Conditions:

Temperature (°C):	20 to 23
Relative Humidity (%):	29 to 34

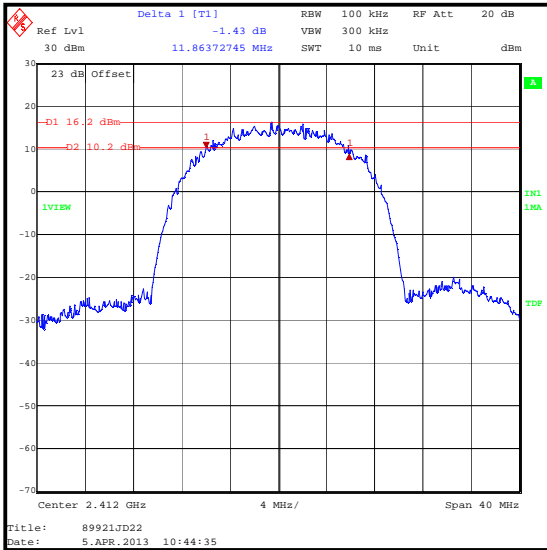
Note(s):

1. All configurations supported by the EUT were investigated on one channel in accordance with KDB 558074 D01 v02 Section 7.1 Option 1 measurement procedure. The data rates that produced the narrowest bandwidth and therefore deemed worst case were:
 - o 802.11b – CCK / 11 Mbps
 - o 802.11g – BPSK / 9 Mbps
2. Final measurements were performed using the above configurations on the bottom, middle and top channels.
3. 802.11b measurements were made using the procedure in 558074 D01 v02 Section 7.1.
4. 802.11g measurements were made using the procedure in 558074 D01 v03 Section 8.1.
5. The spectrum analyser was connected to the RF port on the EUT using suitable attenuation and RF cable.
6. Reference plots have been added at the end of this section for 802.11g 48 Mbps measured in accordance with 558074 D01 v02 section 7.1. The 6 dB bandwidth was used to calculate the span for PSD and output power.

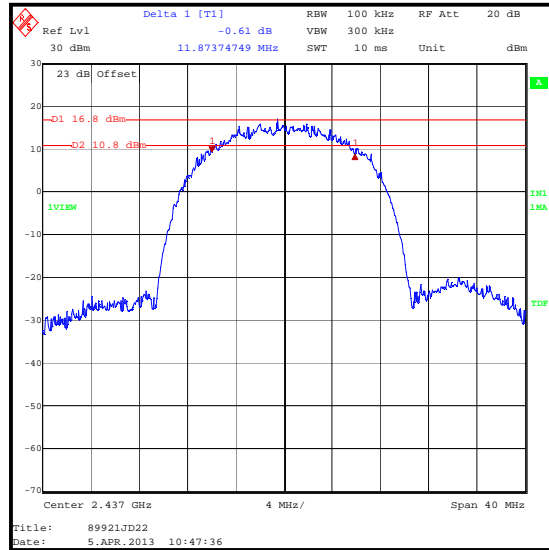
Transmitter Minimum 6 dB Bandwidth (continued)

Results: 802.11b / CCK / 11 Mbps

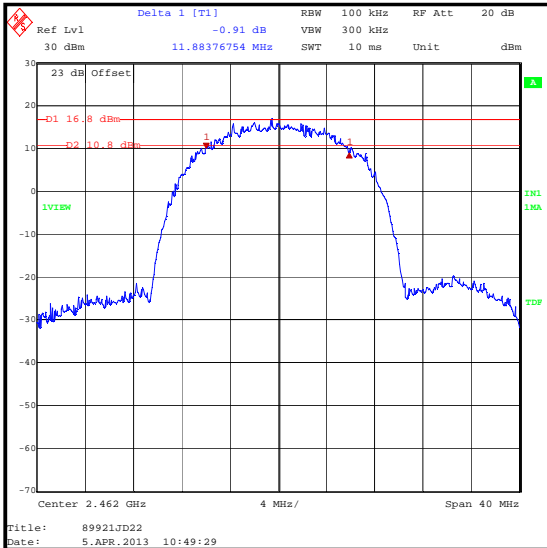
Channel	6 dB Bandwidth (kHz)	Limit (kHz)	Margin (kHz)	Result
Bottom	11863.727	≥500	11363.727	Complied
Middle	11873.747	≥500	11373.747	Complied
Top	11883.768	≥500	11383.768	Complied



Bottom Channel



Middle Channel

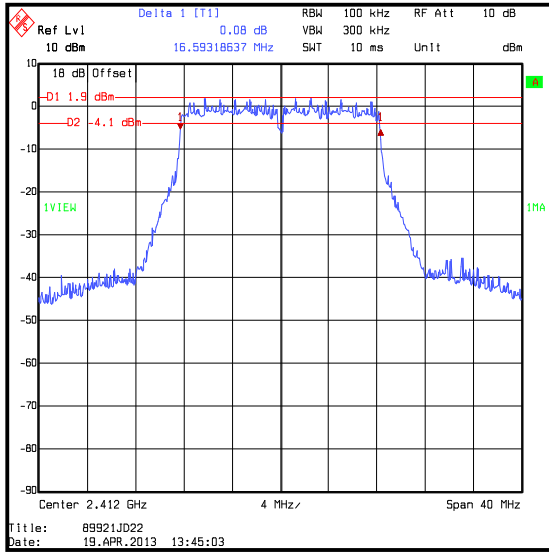


Top Channel

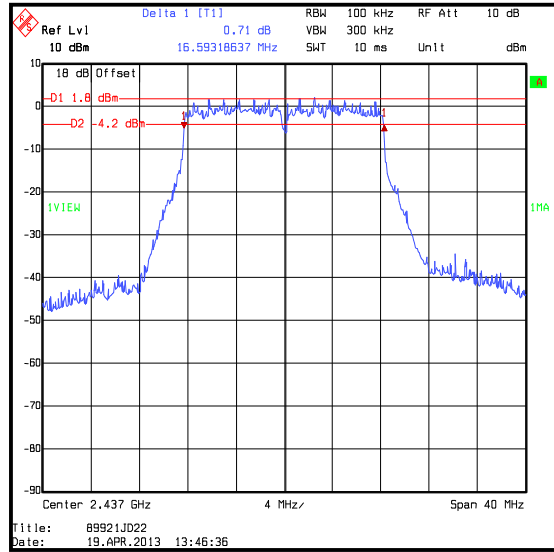
Transmitter Minimum 6 dB Bandwidth (continued)

Results: 802.11g / BPSK / 9 Mbps

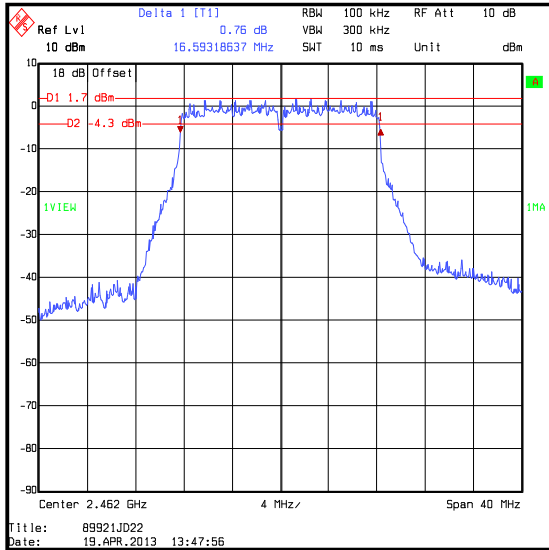
Channel	6 dB Bandwidth (kHz)	Limit (kHz)	Margin (kHz)	Result
Bottom	16593.186	≥500	16093.186	Complied
Middle	16593.186	≥500	16093.186	Complied
Top	16593.186	≥500	16093.186	Complied



Bottom Channel



Middle Channel

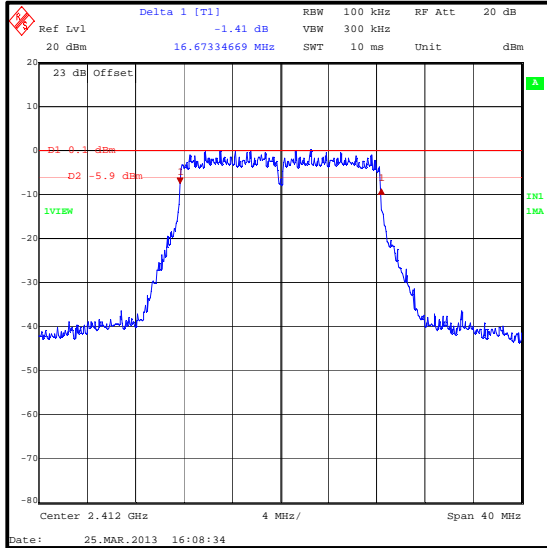


Top Channel

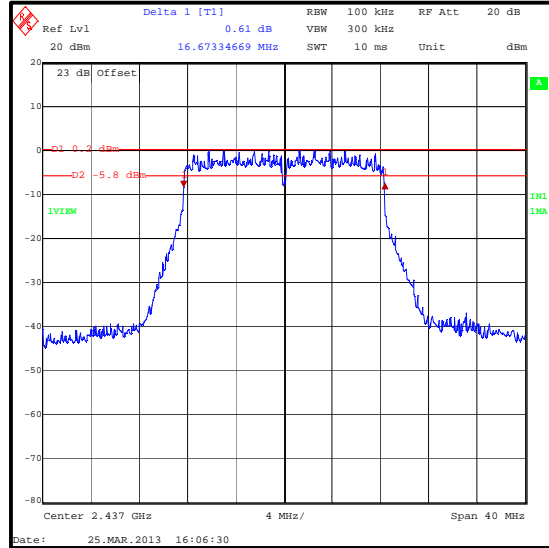
Transmitter Minimum 6 dB Bandwidth (continued)

Results: 802.11g / 64QAM / 48 Mbps (Reference plots)

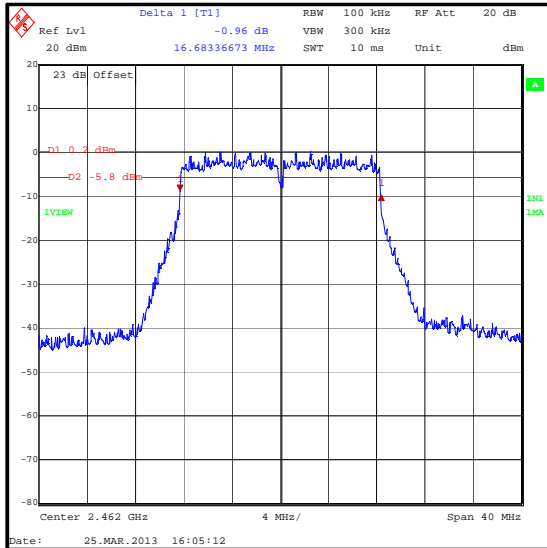
Channel	6 dB Bandwidth (kHz)	Limit (kHz)	Margin (kHz)	Result
Bottom	16673.347	≥500	16173.347	Complied
Middle	16673.347	≥500	16173.347	Complied
Top	16683.367	≥500	16183.367	Complied



Bottom Channel



Middle Channel



Top Channel

Transmitter Minimum 6 dB Bandwidth (continued)**Test Equipment Used:**

Asset No.	Instrument Description	Model Number	Calibration Due	Calibration Interval (Months)
A1996	Huber & Suhner Attenuator	6810.17.B	Calibrated before use	-
A1395	Huber & Suhner Attenuator	6806.17.B	10 May 2013	12
A1393	Huber & Suhner Attenuator	6820.17.B	06 Jul 2013	12
M1124	Rohde & Schwarz Test Receiver	ESIB 26	14 Aug 2013	12
M127	Rohde & Schwarz Spectrum Analyser	FSEB 30	13 Aug 2013	12

In accordance with UKAS requirements all the measurement equipment is on a calibration schedule. All equipment was within the calibration period on the date of testing.

5.2.5. Transmitter 99% Occupied Bandwidth**Test Summary:**

Test Engineer:	Sandeep Bharat	Test Date:	26 April 2013
Test Sample Serial Number:	91257		

FCC Reference:	N/A
Industry Canada Reference:	RSS-Gen 4.6.1
Test Method Used:	Tested using the occupied bandwidth function of a test receiver

Environmental Conditions:

Temperature (°C):	25
Relative Humidity (%):	31

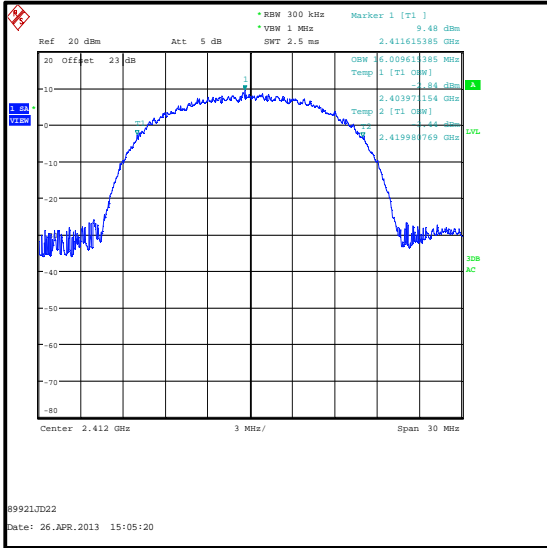
Note(s):

1. Occupied bandwidth (99% bandwidth) was measured using a test receiver occupied bandwidth function with the test receiver set to the appropriate bandwidth according to the channel width under test. Measurement bandwidths were set automatically by the test receiver.
2. All data rates were checked on one channel and the modes which produced the highest power were 802.11b / 11 Mbps and 802.11g / 48 Mbps and therefore chosen for testing as per the specification requirements.
3. The spectrum analyser was connected to the RF port on the EUT using suitable attenuation and RF cable.

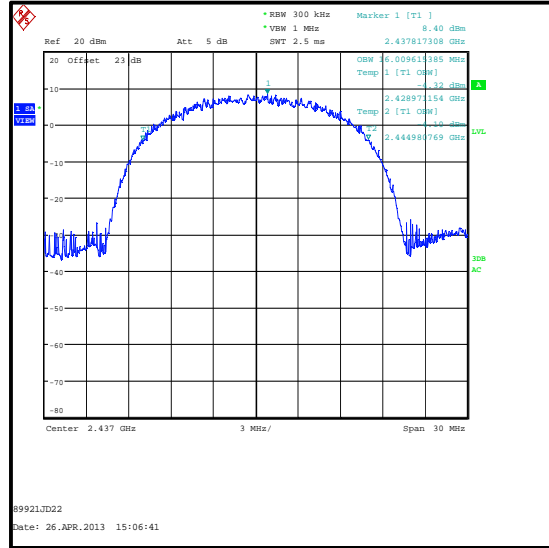
Transmitter 99% Occupied Bandwidth (continued)

Results: 802.11b / CCK / 11 Mbps

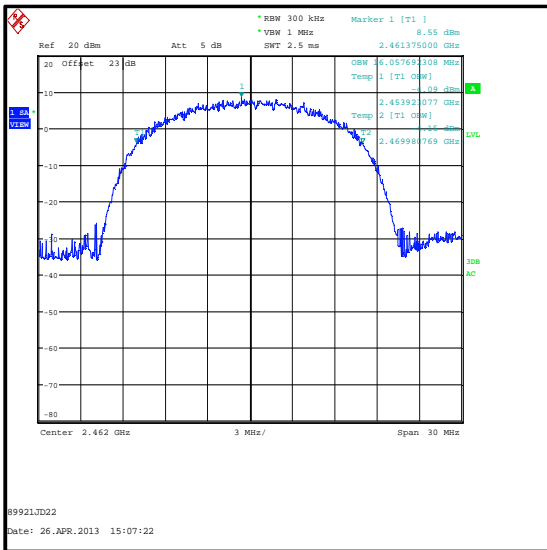
Channel	99% Occupied Bandwidth (kHz)
Bottom	16009.615
Middle	16009.615
Top	16057.692



Bottom Channel



Middle Channel

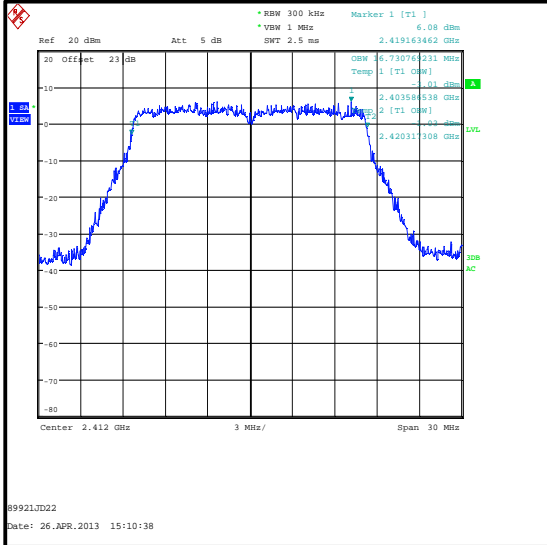


Top Channel

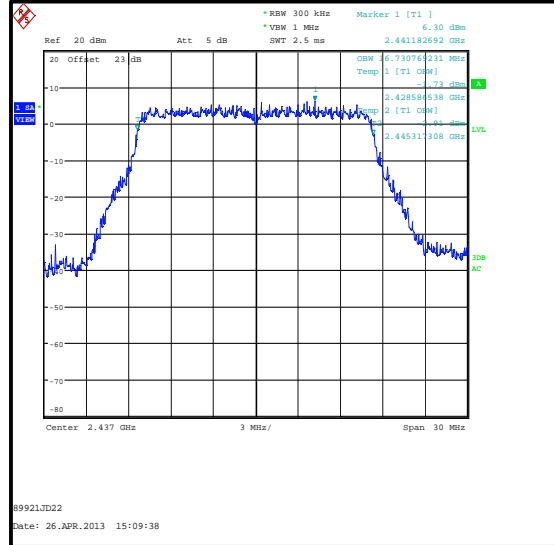
Transmitter 99% Occupied Bandwidth (continued)

Results: 802.11g / 64QAM / 48 Mbps

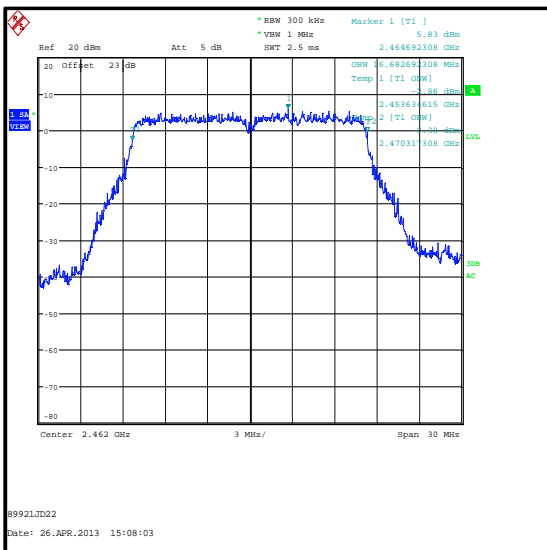
Channel	99% Occupied Bandwidth (kHz)
Bottom	16730.769
Middle	16730.769
Top	16682.692



Bottom Channel



Middle Channel



Top Channel

Transmitter 99% Occupied Bandwidth (continued)**Test Equipment Used:**

Asset No.	Instrument Description	Model Number	Calibration Due	Calibration Interval (Months)
A1393	Huber & Suhner Attenuator	6820.17.B	06 Jul 2013	12
M1630	Rohde & Schwarz Test Receiver	ESU40	07 Feb 2014	12

In accordance with UKAS requirements all the measurement equipment is on a calibration schedule. All equipment was within the calibration period on the date of testing.

5.2.6. Transmitter Power Spectral Density**Test Summary:**

Test Engineer:	Sandeep Bharat	Test Date:	19 April 2013
Test Sample Serial Number:	91257		

FCC Reference:	Part 15.247(e)
Industry Canada Reference:	RSS-210 A8.2(b)
Test Method Used:	As detailed in FCC KDB 558074 D01 v03 Section 10.2

Environmental Conditions:

Temperature (°C):	23
Relative Humidity (%):	34

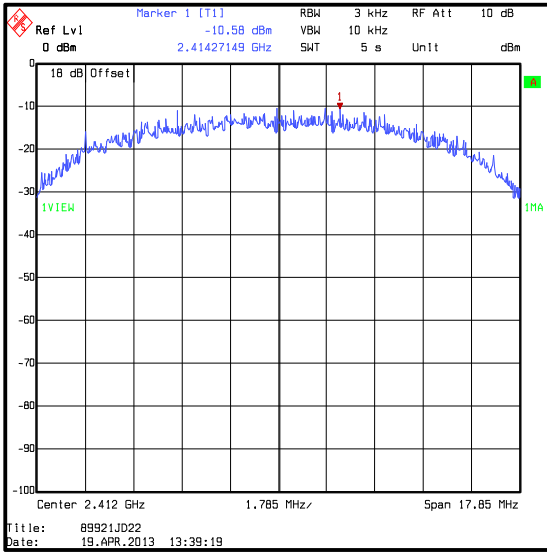
Note(s):

1. All configurations supported by the EUT were investigated on one channel in accordance with FCC KDB 558074 D01 v03 Section 10.2 Method PKPSD measurement procedure. The data rates that produced the highest power and therefore deemed worst case were:
 - 802.11b – CCK / 11 Mbps
 - 802.11g – 64QAM / 48 Mbps
2. Final measurements were performed using the above configurations on the bottom, middle and top channels.
3. The spectrum analyser was connected to the RF port on the EUT using suitable attenuation and RF cable.

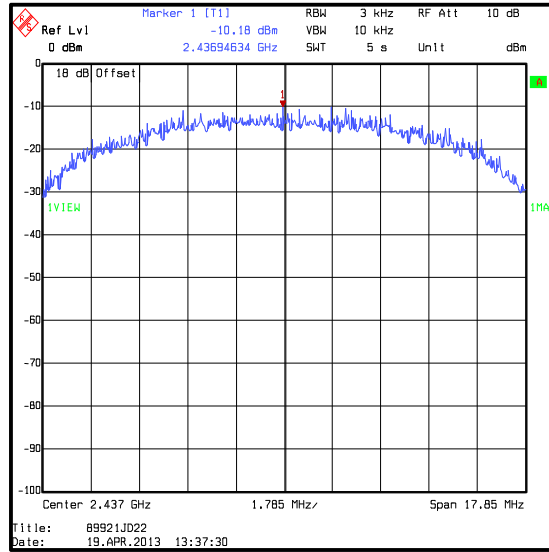
Transmitter Power Spectral Density (continued)

Results: 802.11b / CCK / 11 Mbps

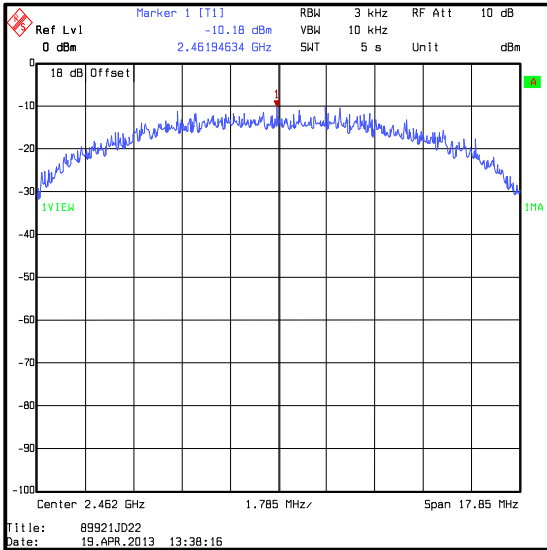
Channel	PSD (dBm/3 kHz)	Limit (dBm/3 kHz)	Margin (dB)	Result
Bottom	-10.6	8.0	18.6	Complied
Middle	-10.2	8.0	18.2	Complied
Top	-10.2	8.0	18.2	Complied



Bottom Channel



Middle Channel

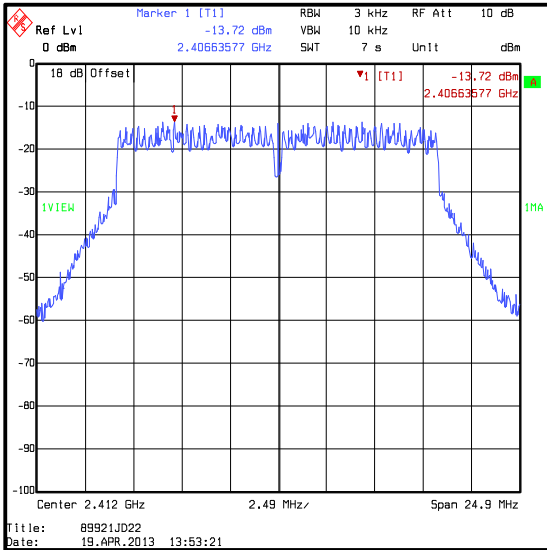


Top Channel

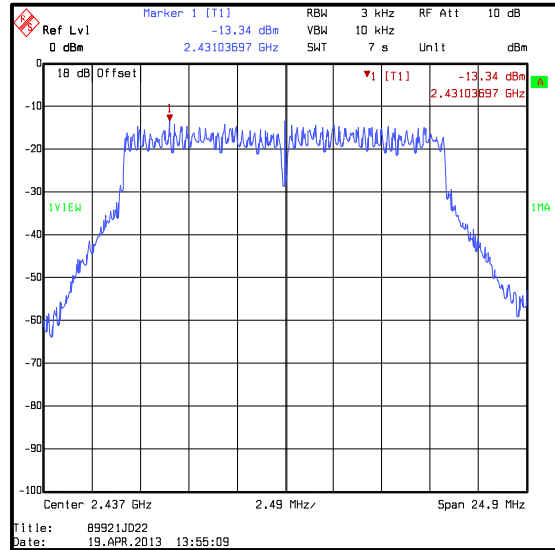
Transmitter Power Spectral Density (continued)

Results: 802.11g / 64QAM / 48 Mbps

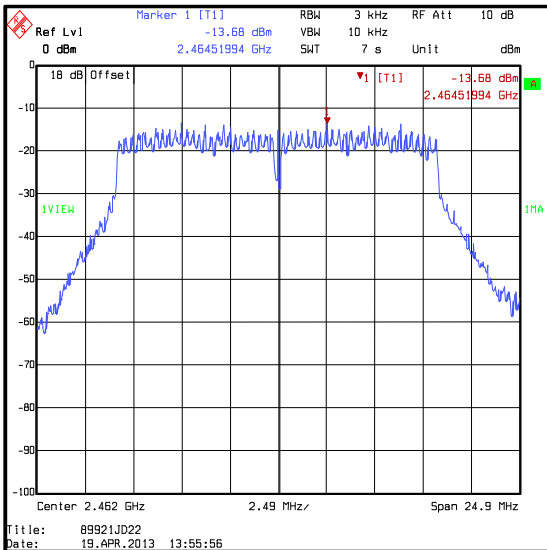
Channel	PSD (dBm/3 kHz)	Limit (dBm/3 kHz)	Margin (dB)	Result
Bottom	-13.7	8.0	21.7	Complied
Middle	-13.3	8.0	21.3	Complied
Top	-13.7	8.0	21.7	Complied



Bottom Channel



Middle Channel



Top Channel

Transmitter Power Spectral Density (continued)**Test Equipment Used:**

Asset No.	Instrument Description	Model Number	Calibration Due	Calibration Interval (Months)
A1996	Huber & Suhner Attenuator	6810.17.B	Calibrated before use	-
A1395	Huber & Suhner Attenuator	6806.17.B	10 May 2013	12
M127	Rohde & Schwarz Spectrum Analyser	FSEB 30	13 Aug 2013	12

In accordance with UKAS requirements all the measurement equipment is on a calibration schedule. All equipment was within the calibration period on the date of testing.

5.2.7. Transmitter Maximum Peak Output Power**Test Summary:**

Test Engineer:	Sandeep Bharat	Test Date:	19 April 2013
Test Sample Serial Number:	91257		

FCC Reference:	Part 15.247(b)(3)
Industry Canada Reference:	RSS-Gen 4.8 / RSS-210 A8.4(4)
Test Method Used:	As detailed in FCC KDB 558074 D01 v03 Section 9.1.2

Environmental Conditions:

Temperature (°C):	23
Relative Humidity (%):	34

Note(s):

1. All configurations supported by the EUT were investigated on one channel in accordance with KDB 558074 Section 9.1.2 Integrated band power method measurement procedure. The data rates that produced the highest power and therefore deemed worst case were:
 - o 802.11b – CCK / 11 Mbps
 - o 802.11g – 64QAM / 48 Mbps
2. Final measurements were performed using the above configurations on the bottom, middle and top channels.
3. The spectrum analyser was connected to the RF port on the EUT using suitable attenuation and RF cable.

Transmitter Maximum Peak Output Power (continued)**Results: 802.11b / CCK / 11 Mbps****Conducted Peak Limit Comparison**

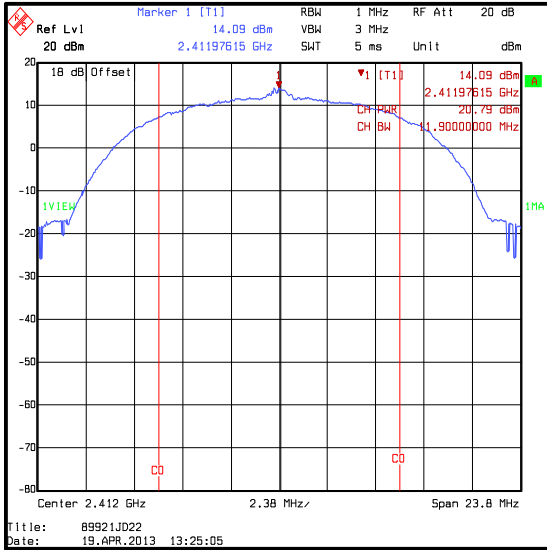
Channel	Conducted Power (dBm)	Conducted Peak Power Limit (dBm)	Margin (dB)	Result
Bottom	20.8	30.0	9.2	Complied
Middle	20.8	30.0	9.2	Complied
Top	20.8	30.0	9.2	Complied

De Facto EIRP Limit Comparison

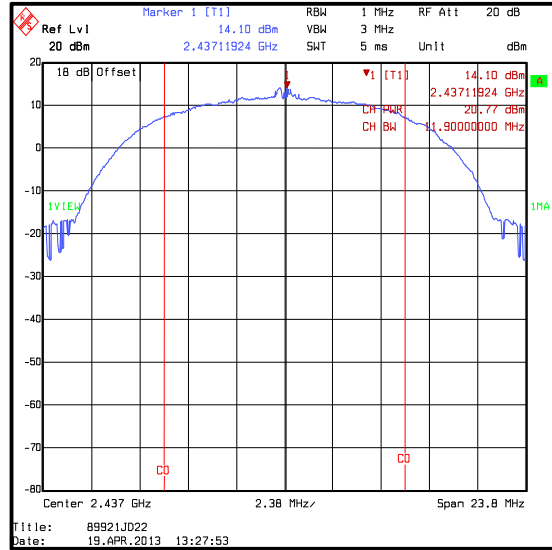
Channel	Conducted Power (dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
Bottom	20.8	1.6	22.4	36.0	13.6	Complied
Middle	20.8	1.6	22.4	36.0	13.6	Complied
Top	20.8	1.6	22.4	36.0	13.6	Complied

Transmitter Maximum Peak Output Power (continued)

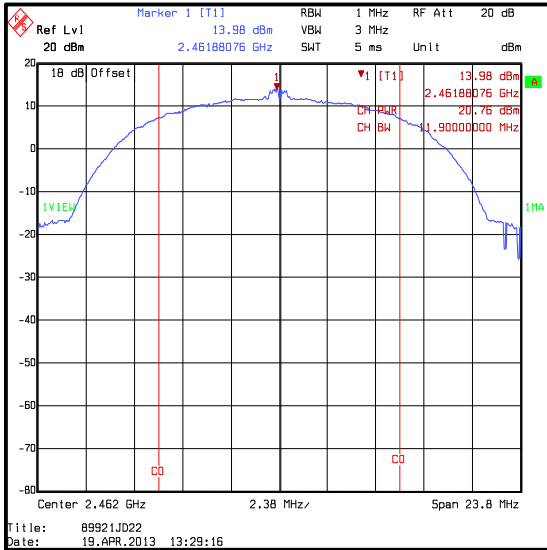
Results: 802.11b / CCK / 11 Mbps



Bottom Channel



Middle Channel



Top Channel

Transmitter Maximum Peak Output Power**Results: 802.11g / 64QAM / 48 Mbps****Conducted Peak Limit Comparison**

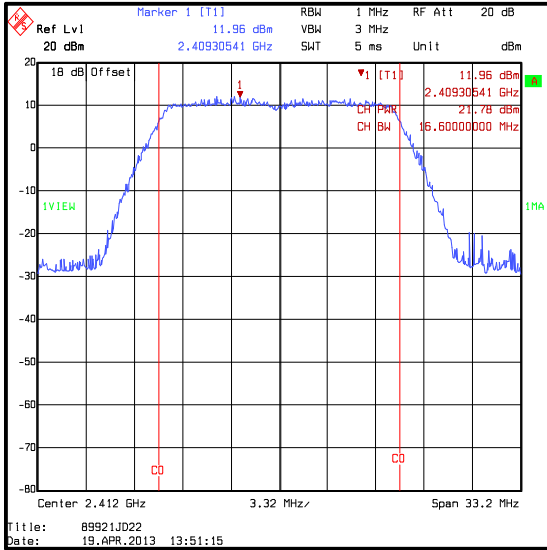
Channel	Conducted Power (dBm)	Conducted Peak Power Limit (dBm)	Margin (dB)	Result
Bottom	21.8	30.0	8.2	Complied
Middle	21.8	30.0	8.2	Complied
Top	21.7	30.0	8.3	Complied

De Facto EIRP Limit Comparison

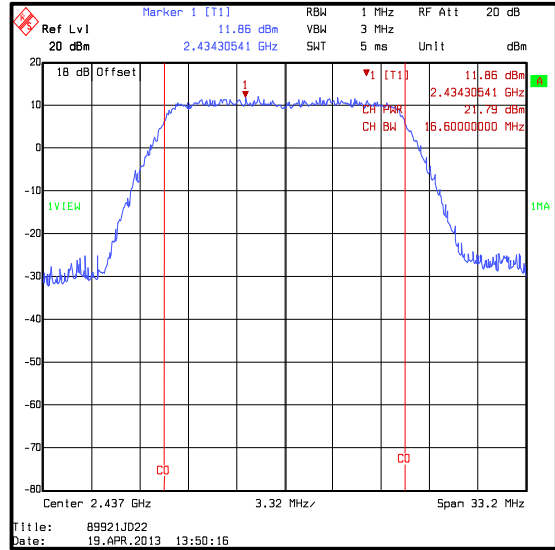
Channel	Conducted Power (dBm)	Declared Antenna Gain (dBi)	EIRP (dBm)	De Facto EIRP Limit (dBm)	Margin (dB)	Result
Bottom	21.8	1.6	23.4	36.0	12.6	Complied
Middle	21.8	1.6	23.4	36.0	12.6	Complied
Top	21.7	1.6	23.3	36.0	12.7	Complied

Transmitter Maximum Peak Output Power

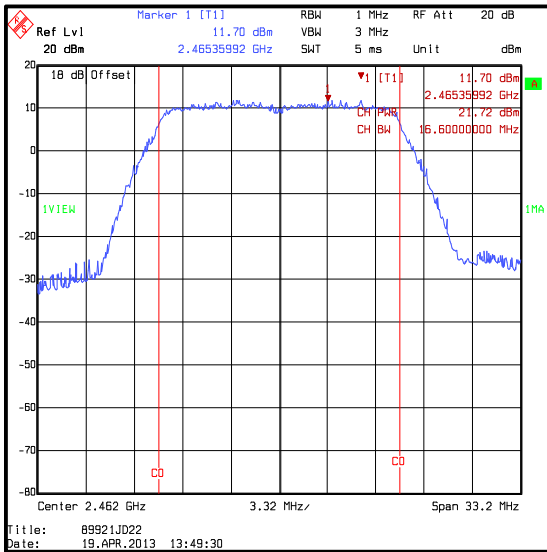
Results: 802.11g / 64QAM / 48 Mbps



Bottom Channel



Middle Channel



Top Channel

Test Equipment Used:

Asset No.	Instrument Description	Model Number	Calibration Due	Calibration Interval (Months)
A1996	Huber & Suhner Attenuator	6810.17.B	Calibrated before use	-
A1395	Huber & Suhner Attenuator	6806.17.B	10 May 2013	12
M127	Rohde & Schwarz Spectrum Analyser	FSEB 30	13 Aug 2013	12

In accordance with UKAS requirements all the measurement equipment is on a calibration schedule. All equipment was within the calibration period on the date of testing.

5.2.8. Transmitter Radiated Emissions**Test Summary:**

Test Engineer:	Sandeep Bharat	Test Date:	19 April 2013
Test Sample Serial Number:	91260		

FCC Reference:	Parts 15.247(d) & 15.209(a)
Industry Canada Reference:	RSS-Gen 4.9 / RSS-210 A8.5
Test Method Used:	As detailed in ANSI C63.10 Sections 6.3 and 6.5 referencing ANSI C63.4
Frequency Range:	30 MHz to 1000 MHz

Environmental Conditions:

Temperature (°C):	23
Relative Humidity (%):	34

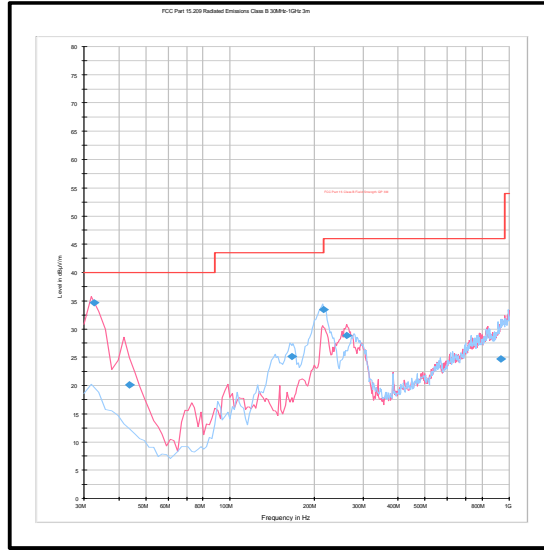
Note(s):

1. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
2. The preliminary scans showed similar emission levels below 1 GHz, for each channel of operation. Therefore final radiated emissions measurements were performed with the EUT set to the top channel only.
3. All other emissions were at least 20 dB below the appropriate limit or below the noise floor of the measurement system.
4. Measurements below 1 GHz were performed in a semi-anechoic chamber (Asset Number K0001) at a distance of 3 metres. The EUT was placed at a height of 80 cm above the reference ground plane in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.

Results:

Frequency (MHz)	Antenna Polarity	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Result
166.307	Horizontal	25.1	43.5	18.4	Complied
261.029	Vertical	28.9	46.0	17.1	Complied

Transmitter Radiated Emissions (continued)



Note: This plot is a pre-scan and for indication purposes only. For final measurements, see accompanying table.

Test Equipment Used:

Asset No.	Instrument Description	Model Number	Calibration Due	Calibration Interval (Months)
K0001	5 m RSE Chamber	Rainford	24 Oct 2013	12
M1124	Test Receiver	ESIB 26	14 Aug 2013	12
A1834	Attenuator	8491B	27 Jan 2014	12
G0543	Amplifier	310N	04 Jul 2013	3
A259	Bilog Antenna	CBL6111	27 Mar 2014	12

In accordance with UKAS requirements all the measurement equipment is on a calibration schedule. All equipment was within the calibration period on the date of testing.

Transmitter Radiated Emissions (continued)**Test Summary:**

Test Engineer:	Sandeep Bharat	Test Date:	19 April 2013
Test Sample Serial Number:	91260		

FCC Reference:	Parts 15.247(d) & 15.209(a)
Industry Canada Reference:	RSS-Gen 4.9 / RSS-210 A8.5
Test Method Used:	As detailed in ANSI C63.10 Sections 6.3 and 6.6 referencing ANSI C63.4
Frequency Range	1 GHz to 25 GHz

Environmental Conditions:

Temperature (°C):	23
Relative Humidity (%):	34

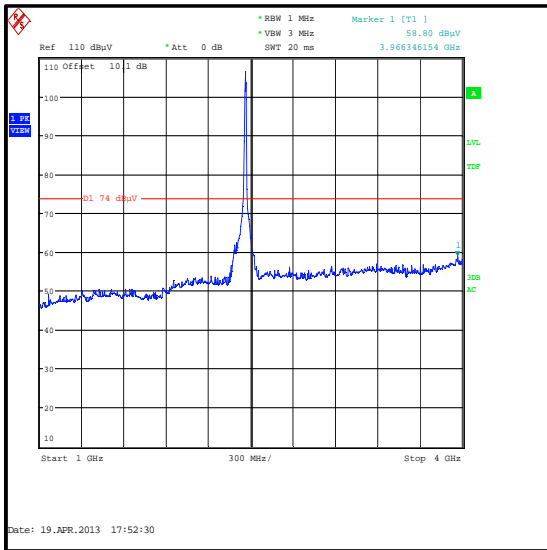
Note(s):

1. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss
2. No spurious emissions were detected above the noise floor of the measuring receiver therefore the highest peak noise floor reading of the measuring receiver was recorded as shown in the table below. The peak level was compared to the average limit as opposed to being compared to the peak limit because this is the more onerous limit.
3. The emission shown at 2462 MHz on the 1 GHz to 4 GHz plot is the EUT fundamental.
4. Pre-scans above 1 GHz were performed in a fully anechoic chamber (Asset Number K0002) at a distance of 3 metres. The EUT was placed at a height of 1.5 metres above the test chamber floor in the centre of the chamber turntable. All measurement antennas were placed at a fixed height of 1.5 metres above the test chamber floor, in line with the EUT. Final measurements above 1 GHz were performed in a semi-anechoic chamber (Asset Number K0001) at a distance of 3 metres. The EUT was placed at a height of 80 cm above the reference ground plane in the centre of the chamber turntable. Maximum emission levels were determined by height searching the measurement antenna over the range 1 metre to 4 metres.

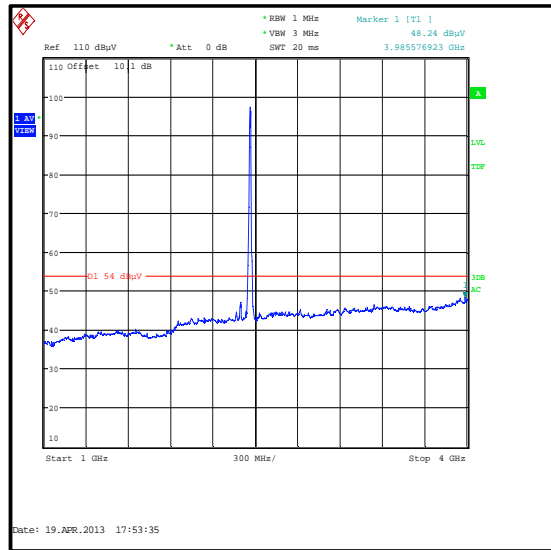
Results:

Frequency (MHz)	Antenna Polarity	Peak Level (dB μ V/m)	Average Limit (dB μ V/m)	Margin (dB)	Result
22711.538	Horizontal	49.6	54.0	4.4	Complied

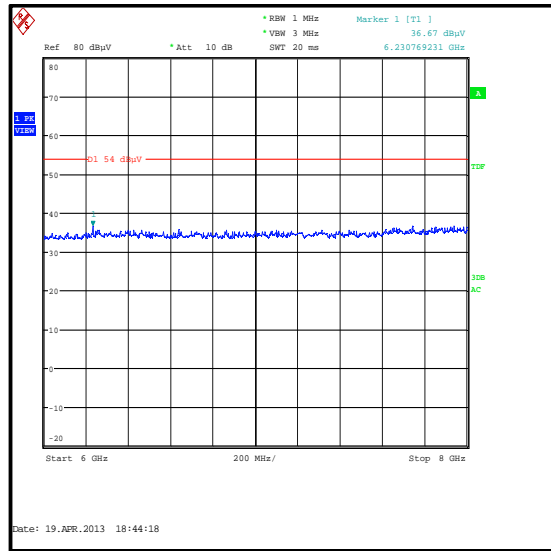
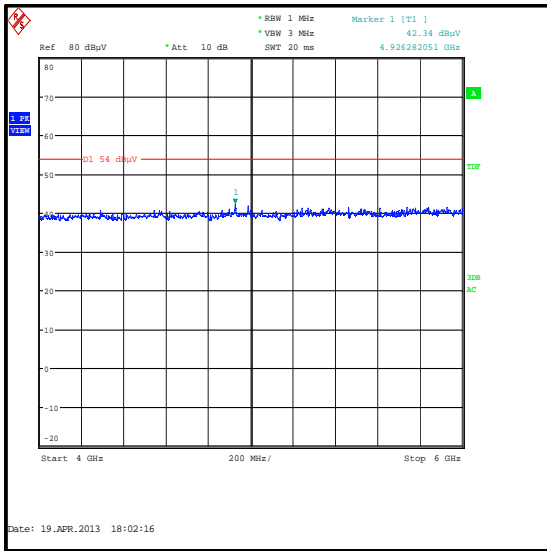
Transmitter Radiated Emissions (continued)



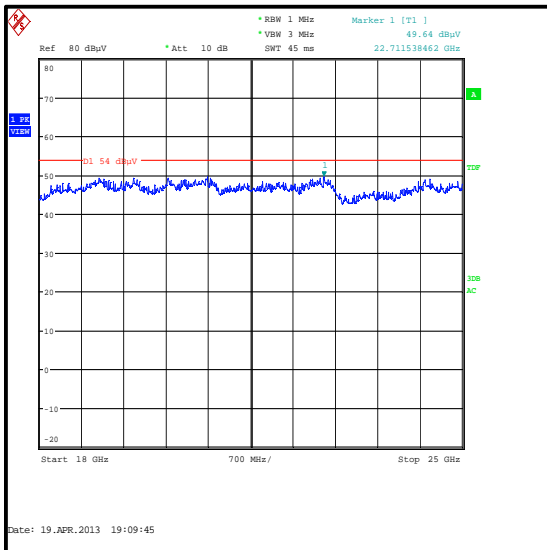
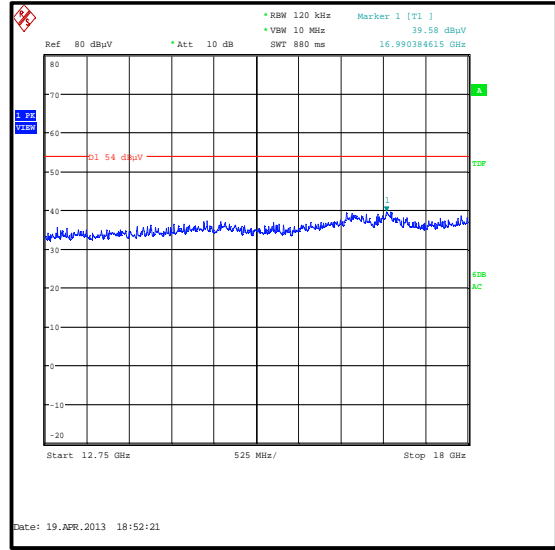
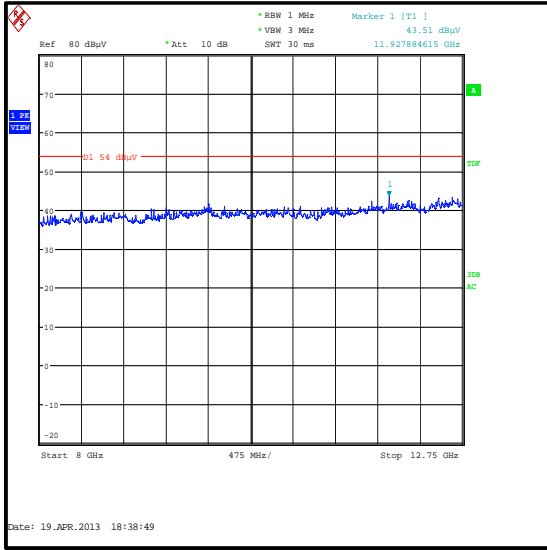
Peak detector



Average detector



Transmitter Radiated Emissions (continued)



Transmitter Radiated Emissions (continued)**Test Equipment Used:**

Asset No.	Instrument Description	Model Number	Calibration Due	Calibration Interval (Months)
A253	Antenna	12240-20	04 Nov 2013	12
A254	Antenna	14240-20	04 Nov 2013	12
A255	Antenna	16240-20	04 Nov 2013	12
A256	Antenna	18240-20	04 Nov 2013	12
A436	Antenna	20240-20	04 Nov 2013	12
A1396	Attenuator	6810.17.B	06 Jul 2013	12
A1534	Pre Amplifier	8449B	04 Nov 2013	12
A1818	Antenna	3115	04 Nov 2013	12
K0002	3m RSE Chamber	Rainford	04 Nov 2013	12
M1630	Rohde & Schwarz Test Receiver	ESU40	07 Feb 2014	12

In accordance with UKAS requirements all the measurement equipment is on a calibration schedule. All equipment was within the calibration period on the date of testing.

5.2.9. Transmitter Band Edge Radiated Emissions**Test Summary:**

Test Engineer:	Sandeep Bharat	Test Date:	19 April 2013
Test Sample Serial Number:	91260		

FCC Reference:	Parts 15.247(d) & 15.209(a)
Industry Canada Reference:	RSS-Gen 4.9 / RSS-210 A8.5
Test Method Used:	As detailed in FCC KDB 558074 D01 v03 Section 13.1 referencing ANSI C63.10 Section 6.9.2

Environmental Conditions:

Temperature (°C):	23
Relative Humidity (%):	34

Note(s):

1. The final measured value, for the given emission, in the table below incorporates the calibrated antenna factor and cable loss.
2. All supported modes and channel widths were initially investigated on one channel. The modes that produced the widest bandwidths were:
 - 802.11b – DQPSK / 2 Mbps
 - 802.11g – 64QAM / 54 Mbps
3. * -20 dBc limit.

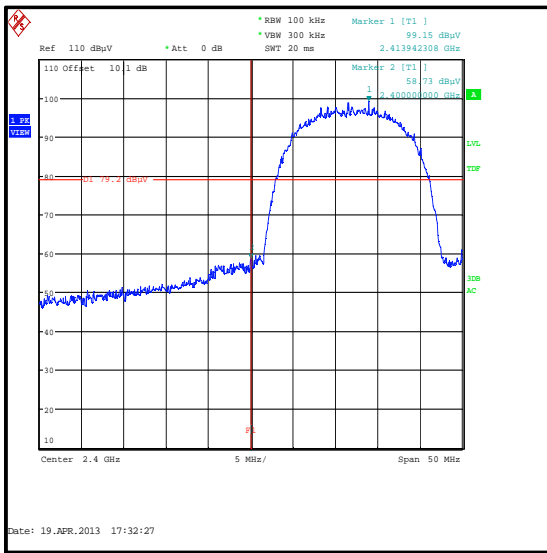
Transmitter Band Edge Radiated Emissions (continued)

Results: 802.11b / 2 Mbps / Peak

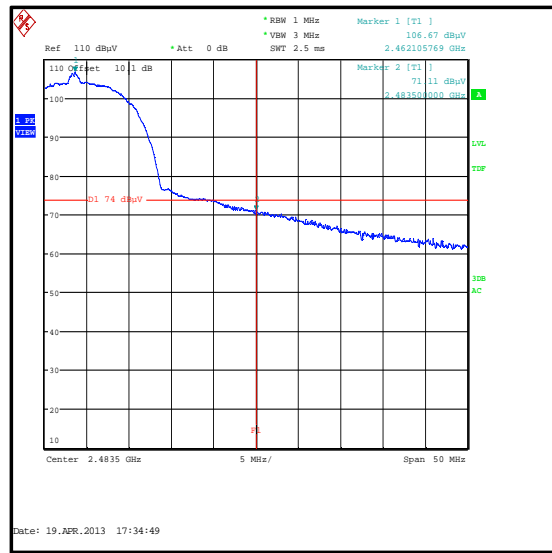
Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
2400	58.7	79.2*	20.5	Complied
2483.5	71.1	74.0	2.9	Complied

Results: 802.11b / 2 Mbps / Average

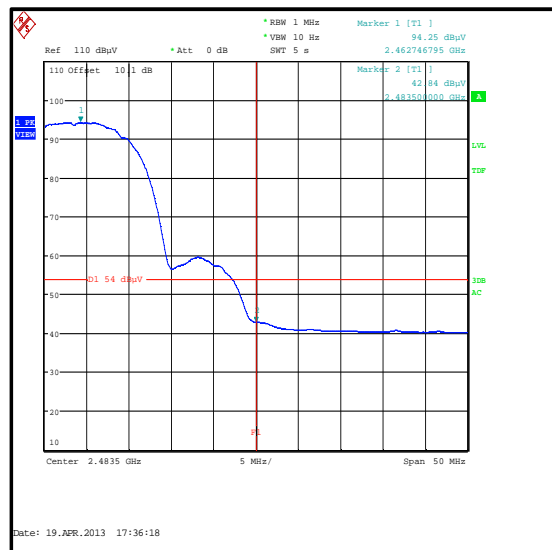
Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
2483.5	42.8	54.0	11.2	Complied



Lower Band Edge Peak Measurement



Upper Band Edge Peak Measurement



Upper Band Edge Average Measurement

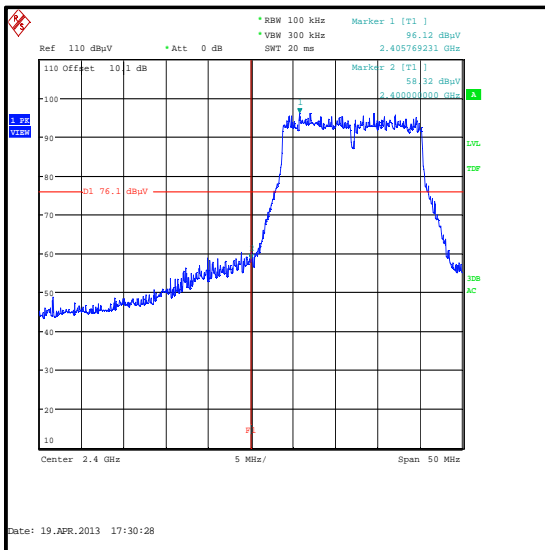
Transmitter Band Edge Radiated Emissions (continued)

Results: 802.11g / 54 Mbps / Peak

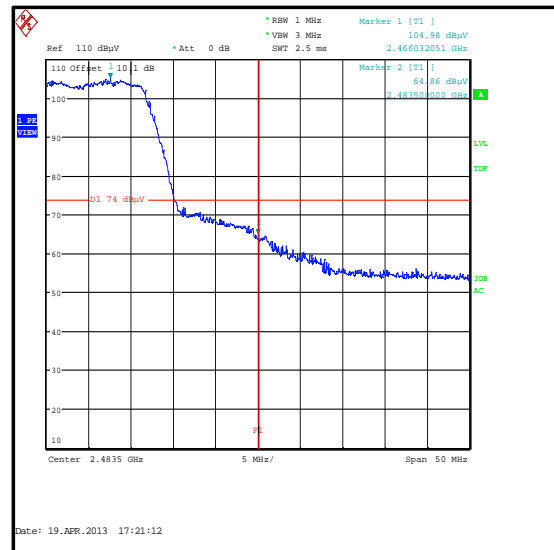
Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
2400	58.3	76.1	17.8	Complied
2483.5	64.9	74.0	9.1	Complied

Results: 802.11g / 54 Mbps / Average

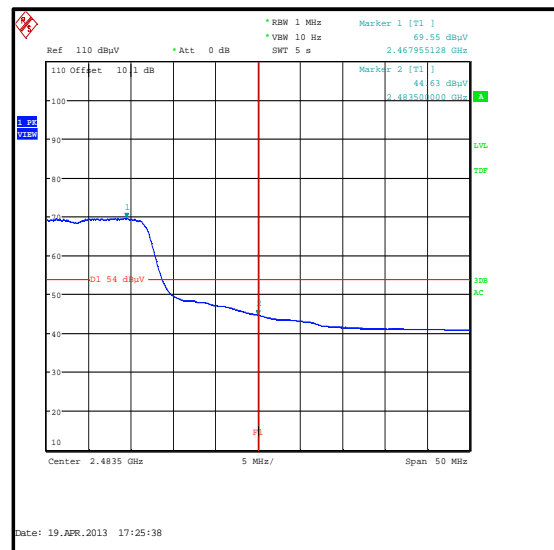
Frequency (MHz)	Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
2483.5	44.6	54.0	9.4	Complied



Lower Band Edge Peak Measurement



Upper Band Edge Peak Measurement



Upper Band Edge Average Measurement

Transmitter Band Edge Radiated Emissions (continued)**Test Equipment Used:**

Asset No.	Instrument Description	Model Number	Calibration Due	Calibration Interval (Months)
A1396	Attenuator	6810.17.B	06 Jul 2013	12
A1534	Pre Amplifier	8449B	04 Nov 2013	12
A1818	Antenna	3115	04 Nov 2013	12
K0002	3m RSE Chamber	Rainford	04 Nov 2013	12
M1630	Rohde & Schwarz Test Receiver	ESU40	07 Feb 2014	12

In accordance with UKAS requirements all the measurement equipment is on a calibration schedule. All equipment was within the calibration period on the date of testing.

6. Measurement Uncertainty

No measurement or test can ever be perfect and the imperfections give rise to error of measurement in the results. Consequently the result of a measurement is only an approximation to the value of the measurand (the specific quantity subject to measurement) and is only complete when accompanied by a statement of the uncertainty of the approximation.

The expression of uncertainty of a measurement result allows realistic comparison of results with reference values and limits given in specifications and standards.

The uncertainty of the result may need to be taken into account when interpreting the measurement results.

The reported expanded uncertainties below are based on a standard uncertainty multiplied by an appropriate coverage factor such that a confidence level of approximately 95% is maintained. For the purposes of this document "approximately" is interpreted as meaning "effectively" or "for most practical purposes".

Measurement Type	Range	Confidence Level (%)	Calculated Uncertainty
AC Conducted Spurious Emissions	0.15 MHz to 30 MHz	95%	±4.69 dB
Conducted Maximum Peak Output Power	2.4 GHz to 2.4835 GHz	95%	±1.13 dB
Power Spectral Density	2.4 GHz to 2.4835 GHz	95%	±1.13 dB
6 dB Bandwidth	2.4 GHz to 2.4835 GHz	95%	±0.92 ppm
99% Occupied Bandwidth	2.4 GHz to 2.4835 GHz	95%	±0.92 ppm
Radiated Spurious Emissions	30 MHz to 26.5 GHz	95%	±2.94 dB

The methods used to calculate the above uncertainties are in line with those recommended within the various measurement specifications. Where measurement specifications do not include guidelines for the evaluation of measurement uncertainty the published guidance of the appropriate accreditation body is followed.

7. Report Revision History

Version Number	Revision Details		
	Page No(s)	Clause	Details
1.0	-	-	Initial Version
2.0	-	-	FCC ID & IC Certification number updated. Section 3.6 Antenna information added.
3.0	-	-	Updates to sections 3.2 & 4.2. Addition of reference plots in section 5.2.4. Addition of note under test equipment tables.